Ultralight Nanolattices with Co-Optimized Mechanical, Thermal, and Optical Properties

Completed Technology Project (2012 - 2016)

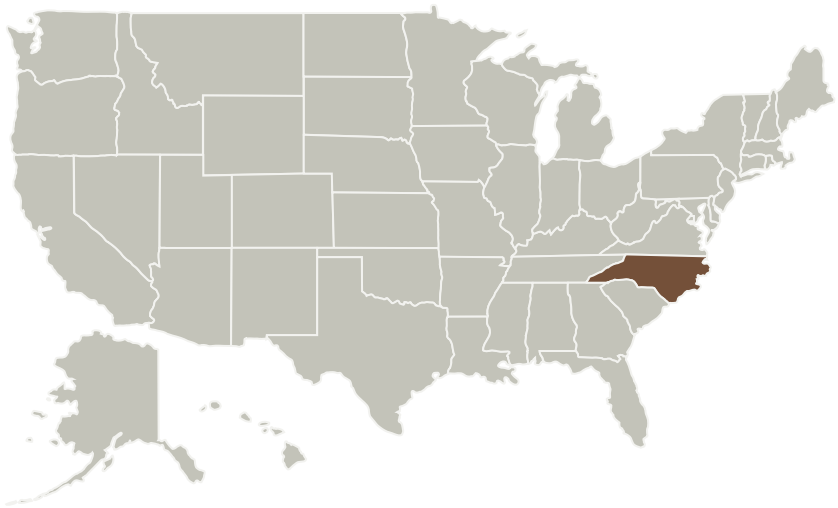
Project Introduction

This research aims to develop ultralight nanostructured materials with optimized properties in multiple physical domains. The proposed approach is based on 3-dimensional nanolattices constructed systematically from hollow-core elements. Using subwavelength lattice parameters and hollow construction, the nanolattice can be designed to simultaneously have low density, low thermal conductivity, and high optical clarity. The structure will be fabricated using novel 3D nanolithography techniques and atomic layer deposition, allowing control of structure parameters with nanometer-level precision. Analogous to the modern architectural approach of designing ordered "steel-lattice structures" for optimal mechanical stability in civil infrastructures (towers, bridges, and skyscrapers), this research program will develop the design and fabrication tools to enable "nano-lattice materials." This research will enable materials with properties that can be directly tailored, and can find applications in ultralight, impact-absorbing, transparent, thermal insulating windows.

Anticipated Benefits

Analogous to the modern architectural approach of designing ordered 'steel-lattice structure's for optimal mechanical stability in civil infrastructures (towers, bridges, and skyscrapers), this research program will develop the design and fabrication tools to enable 'nano-lattice materials'. This research will enable materials with properties that can be directly tailored, and can find applications in ultralight, impact-absorbing, transparent, thermal insulating windows.

Primary U.S. Work Locations and Key Partners



Project Image Ultralight Nanolattices with Co-Optimized Mechanical, Thermal, and Optical Properties

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Organizations Performing Work	Role	Type	Location
North Carolina State University at Raleigh	Lead Organization	Academia	Raleigh, North Carolina

Primary U.S. Work Locations
North Carolina

Images

11475-1363267846716.jpg
Project Image Ultralight Nanolattices with Co-Optimized Mechanical, Thermal, and Optical Properties
(https://techport.nasa.gov/image/1838)

Project Website:

https://www.nasa.gov/directorates/spacetech/home/index.html

Organizational Responsibility

Responsible Mission Directorate:
Space Technology Mission Directorate (STMD)

Lead Organization:
North Carolina State University at Raleigh

Responsible Program:
Space Technology Research Grants

Project Management

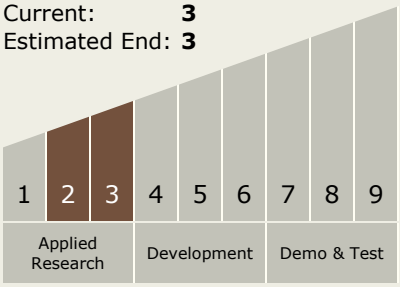
Program Director:
Claudia M Meyer

Program Manager:
Hung D Nguyen

Principal Investigator:
Chih-hao Chang

Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



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Technology Areas

Primary:

- TX14 Thermal Management Systems
  - TX14.3 Thermal Protection Components and Systems
    - TX14.3.1 Thermal Protection Materials

Target Destination

Mars